Journal of Siberian Federal University. Engineering & Technologies 5 (2012 5) 554-559
~ ~ ~

УДК 622.7

Search for the New Form of Raw Material for the Alyumineevoy Industry of Siberiaode

Vera I. Bragina,
Natalyi I. Konnova* and Lybov P. Pehova
Siberial Federal University
79 Svobodny, Krasnoyarsk, 660041 Russia [1]

Received 06.09.2012, received in revised form 13.09.2012, accepted 20.09.2012

This article presents the results of research into rational schemes ore enrichment Bazybajsk deposit (Krasnoyarsk region). Optimal conditions for sillimanit and quartz concentrates.

Keywords: quartz-sillimanite schists, sillimanite concentrate, quartz concentrate, Bazybajsky district, flotation, wet magnetic separation, gravity-flotation-magnetic and magnetic- flotation- magnetic circuits.

Introduction

The urgency of the given work is connected with necessity of involving for sphere of industrial use of new kinds of aluminum raw materials in Siberia. The reconnoitered stocks of aluminum raw materials in Siberia, and in Krasnoyarsk region in particular, are great enough. However now nepheline ores are developed only. And, from more than 100 known nepheline ores deposits in Siberia the industry masters only one – the Cue-Shaltyrsky, which is in a complex processed on Open Society «Achinsk aluminous industrial complex» from 1971. For today the Cue-Shaltyrsky deposit is substantially fulfilled, and, according to the All-Russia Aljuminievo-magnesian Institute, can provide industrial complex with alumina raw materials only till 2020.

On Bazybay look-ahead resources of ore even according to the most conservative estimates exceed 410 million tons that is equivalent to 65 million tons of alumina.

Problem of the given researches was studying of material structure and washability of sillimanite ores of the Bazybajsky deposit for the purpose of finding-out of possibility of its industrial complex use.

Materials and methods of researches

The institutes Irgiredmet, in Mehanobr, Irkutsk polytechnical institute and the Kazan branch of the Academy of Sciences earlier were engaged in studying обогатимости sillimanite ores. The basic attention was given to two deposits – Kjahtinsky and Kitojsky in which ores depending on material structure, dispersion of minerals and character of their accretion can be enriched on gravitation-

* Corresponding author E-mail address: kni757@mail.ru

flotation,magnetic-flotation or to other combined schemes. However any of these deposits isn't started up in operation.

We study sample of quartz- ore of a district Bazybajsky, containing 74 % of quartz, 19 % of sillimanite and in small quantities (to 0,5 %) a pyrite, rutile, a topaz, a magnetite, iron hydrooxides. The maintenance of oxide of chemical elements in sample has made: Al_2O_3 – 13,7, SiO_2 – 80,6, Fe_2O_3 – 1,25, TiO_2 – 0,7 %.

Sillimanite is presented by two varieties: lamellar and needle (fibrolite), which prevailing sizes in a diameter fluctuate from 0,04 to 0,2 mm (prismatic) and from 0,002 to 0,02 mm (needle).

Thin dispersion of sillimanite has defined the necessity of application first of all a flotation method of enrichment. Flotation researches were spent on the initial ore crushed to size of 100 % – 0,074 mm. The mechanical floatation machine FM-187 was used for flotation.

Studying of influence of reagents on flotation factors were spent by a classical method and a method of statistical planning of experiment by means of the multilevel factor plan $3^3/9$.

On the basis of our previous researches as the collector for sillimanite flotation soap distilled oils (SDTO), a regulator pH pulps – soda, a burden depressor – alkali silicate was used.

At selection of a reagent conditions and number of floatation machine impeller turns spent only the rough flotation. In experiences on studying of influence of the expense of reagents on factors of enrichment pulp density at agitation 50 %, at flotation – 20 % supported, number of impeller turns at agitation – 2200, at flotation – 2000 rpm.

Results of researches

Expense SDTO changed from 170 to 1300 g/t. For the optimum expense 170 g/t (Fig. 1) at which maintenance Al_2O_3 in a foamy product (a concentrate of the rough flotation) has made 16 % at extraction – 97 % is accepted.

At the optimum expense of the collector (170 g/t) influence pH pulps (Fig. 2) on flotation factors was studied. Level pH was created by soda (the expense from 300 to 1800 g/t), thus pH changed from

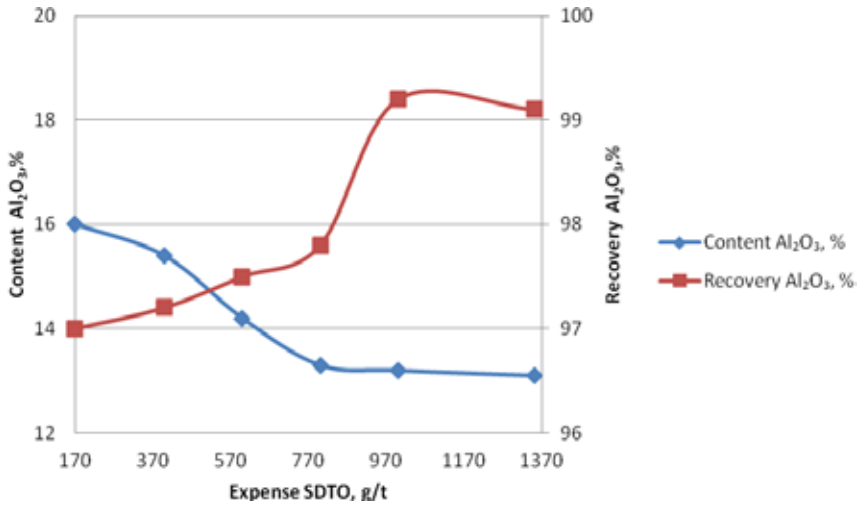

Fig. 1. Influence of the expense of the collector on flotation factors

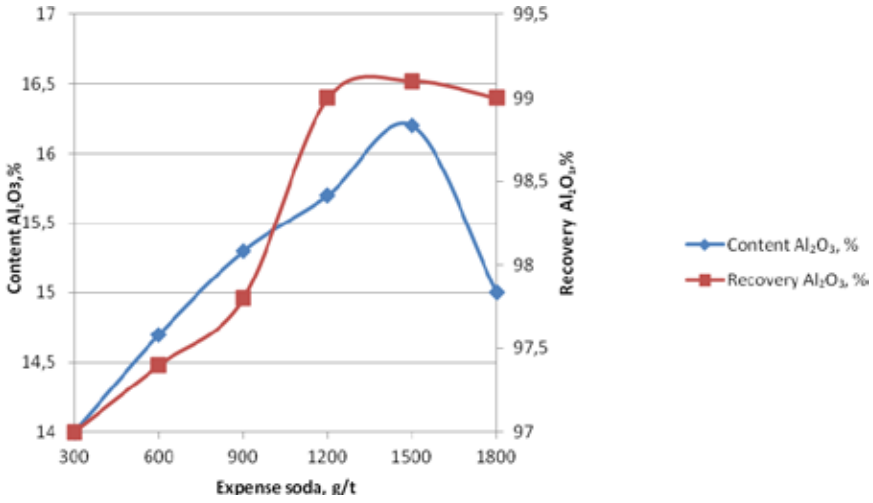

Fig. 2. Influence of the expense of a regulator pH pulps on flotation factors

8,2 to 10,2. The highest factors of enrichment are received at the expense of soda 1500 g/t (pH = 9,5). Thus maintenance Al_2O_3 in a concentrate has made 16,2, extraction – 99,1 % accordingly.

Influence of alkali silicate (Fig. 3) on results of flotation was investigated at the optimum expense of the collector (170 g/t) and soda (1500 g/t). The best factors of flotation are received at the expense of alkali silicate 120 g/t. Thus maintenance Al_2O_3 in a concentrate has made 16,5 %, extraction – 98,84 %, that is alkali silicate doesn't raise results of flotation.

Research of influence of density of a pulp and number of turns at agitation and flotation on enrichment factors was spent at expense SDTO 170g/t, soda – 1500 g/t, alkali silicate – 120 g/t. The highest the maintenance and extraction of sillimanite in a foamy product are received at originally chosen values (at agitation and flotation) pulp density (accordingly 50 and 20 %) and numbers of turns (accordingly 2200 and 2000 rpm).

For the purpose of elimination of influence of the collateral factors appearing at long researches, statistical planning of experiment has been applied. For research of influence of entrance factors (the expense of soda, SDTO, alkali silicate, pulp density at agitation and flotation, numbers of impeller turns at agitation and flotation) for the outlet parameters (extraction and maintenance Al_2O_3) and for reception of mathematical models the multilevel factorial design 33/9 which is orthogonal concerning model of the main effects has been used that allows to estimate the main effects of all factors independently from each other has been used.

Optimum values of expenses of reagents are defined: soda (1300 g/t); SDTO (400 g/t); alkali silicate (120 g/t); pulp density at agitation (50 %) and flotation (25 %); numbers of turns at agitation (2250 rpm) and flotation (2000 rpm). Thus maintenance Al_2O_3 in a concentrate and its extraction in a concentrate practically don't differ from the received results by classical method.

Results discussion

The analysis of flotation factors by various conditions shows that process is steady and can be easily carried out in industrial conditions.

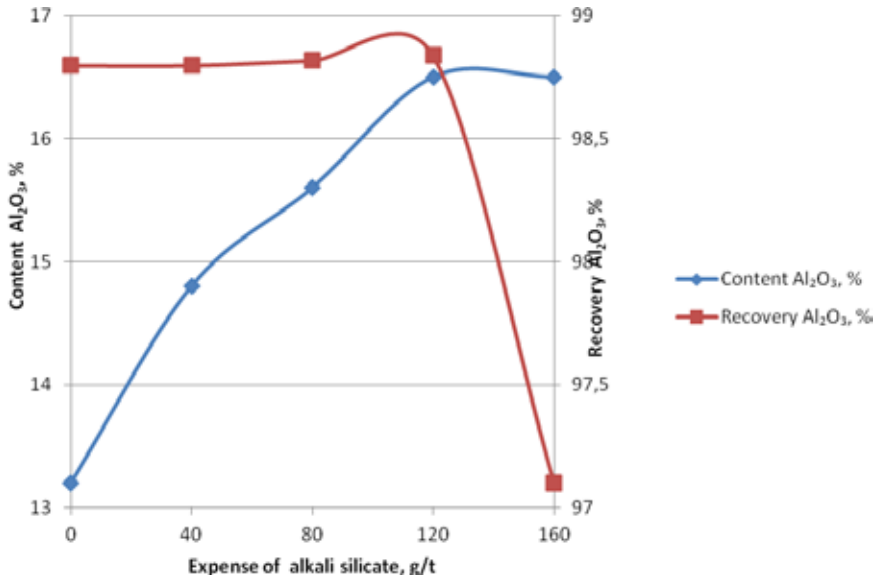

Fig. 3. Influence of the expense of a depressor on flotation factors

By earlier spent researches [3] it is revealed that for the purpose of decreasing the maintenance of harmful impurity (ferric oxide, titan dioxide) in concentrates including in sillimanite one, it is expedient to apply wet magnetic separation in the stronger field. It was used by working out of schemes of enrichment. Using an optimum mode of flotation, enrichment of initial ore under two schemes is spent: gravitation and flotation-magnetic and magnetic and flotation-magnetic.

The gravitation and flotation-magnetic scheme includes separation of initial ore with size 100 % – 0,074 mm (on a screw separator), the rough sillimanite flotation from easy separation fraction with the subsequent 4 cleaner flotations of a foamy product and wet magnetic separation a sillimanite concentrate in the stronger field. The sillimanite concentrate contained aluminum oxides 52,8, iron – 0,55, titan dioxide – 1,5 % at extraction of an aluminum oxide 54,3 %.

Under the magnetic and flotation-magnetic scheme the sillimanite concentrate was allocated as a result of wet magnetic separation of initial ore in the stronger field and the subsequent rough flotation of not magnetic fraction with 4 cleaner flotation of a foamy product. The concentrate of the fourth cleaner flotation was exposed to separation in the stronger field for the purpose of decrease in the maintenance of harmful impurity in a final concentrate. Under the scheme with the closed cycle (Fig. 4) is received a sillimanite concentrate in number of 20 % with the maintenance of an aluminum oxide 52,6, iron – 0,6, the titan dioxides – 1,54 at extraction of an aluminum oxide 74,1 % accordingly. The concentrate can be used in manufacture of high-clayey fire-resistant materials, in which maintenance Al_2O_3 not less than 45 %, or for manufacture of aluminum and its alloys, or in the petrochemical industry for reception of the synthetic catalyst. And, in 70 th years of the last century scientists of the Moscow institute of the petrochemical and gas industry the new effective catalyst for petrochemistry and oil refining with use of sillimanite mineral was developed.

The reject of the flotation enrichment containing 95 % SiO_2, represent a quartz product, suitable for use as raw materials for the fire-resistant and ceramic industries.

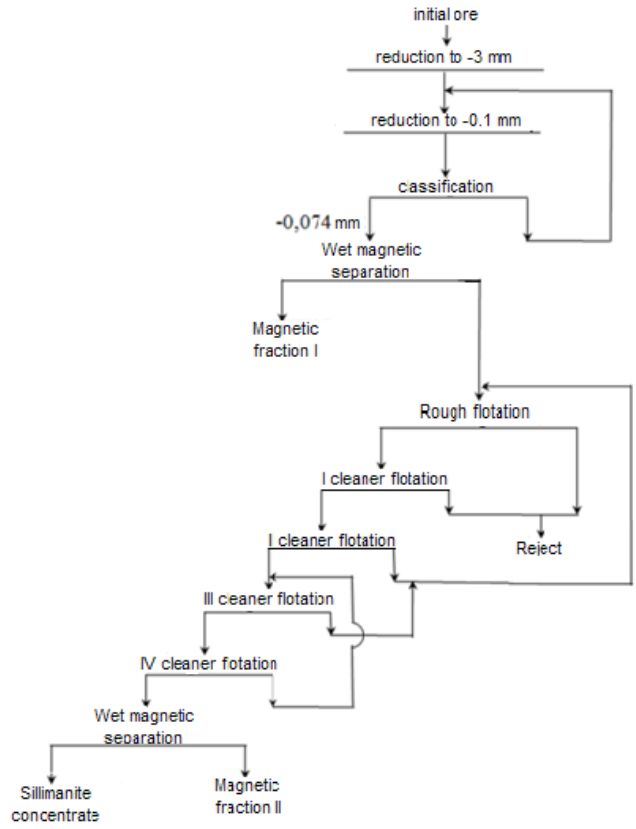

Fig. 4. An enrichment Circuit diagram of sillimanite slates of district Bazybajsky

Conclusions

1. Researches on studying of material structure of sillimanite ore and products of its enrichment are conducted.

2. The influence on flotation factors is studied: concentration of SDTO, soda, alkali silicate, density of a pulp and number of impeller turns. Optimum indicators of enrichment are received at the expense of the collector 170 g/t, soda – 1500 g/t, liquid glass – 80 g/t, pulp density at agitation of 50 % firm, at flotation – 20 %, numbers of impeller turns at agitation 2200 and 2000 rpm at flotation.

3. Comparative enrichment of initial ore under two schemes is spent: Gravitation and flotation-magnetic and magnetic and flotation-magnetic.

4. The magnetic and flotation-magnetic scheme of enrichment of ore of Bazybajsky district is recommended.

5. A sillimanite concentrate, with the maintenance of an aluminum oxide 52,6, iron – 0,6, the titan dioxides – 1,54 at extraction of an aluminum oxide 74,1 % accordingly, can be used in manufacture high-clayey fire-resistant materials, for manufacture of aluminum and its alloys, in the petrochemical industry for reception of the synthetic catalyst.

6. Reject of enrichment can be used as a quartz concentrate. On the conclusion of institutes Sibtsementniiproekt (Krasnoyarsk) and VNIISTROM the quartz concentrate can be used as an active mineral and correcting siliceous additive by manufacture Portland. On the conclusion of East institute

of grogs (Ekaterinburg) the quartz concentrate can be a component furnace charge by manufacture of silicate building materials and in the fire-resistant industry – as a siliceous component of silica mortar powder.

7. The offered technology allows to organize the rational complex of enrichment of ore of the Bazybajsky district with reception of valuable commodity products: sillimanite concentrate (SK) for the aluminous industry and extremely scarce quartz sand for Krasnoyarsk region and other economic region of Siberia.

Thus, ore of the Bazybajsky district can be a new kind of raw materials for the aluminum industry and quartz sand for various industries.

References

[1] *Abramov A.A.* Flotation enrichment methods: the textbook for HIGH SCHOOLS. T.4 – M: MSTU, 2008. 707p.

[2] *Algebraistova N.K.* Feature of material structure and technology of enrichment of bauxites of the Timansky deposit/N.K. Algebraistova, S.A.Markova, N.V.Filenkova, L.I.Sviridov, A.A.Labutina, E.A.Groo, A.V.Smolkova//the Mountain information-analytical bulletin (scientific and technical magazine). 2009. № 6. P.201-211.

[3] Research for the purpose of enrichment working out of titaniumcontent sillimanite slates of the Kjahtinsky deposit (report). Pogodaev M. A, etc. Funds of institute «Сибцветметниипроект», Krasnoyarsk, 1958.

[4] *Popova N.V.* Feature of territorial structure of a power production cycle of Sibirean aluminum // Geography and natural resources. 2006. № 1. P.96-104.

[5] *Smirnova T.A.* Condition of a raw-material base of Russian and world aluminum industry // Economic problems and decisions. 2005. № 4. P. 49-60.

[6] *Sokolov V.M.* Assessment of prospects of manufacture and aluminum consumption in Russia // Economic problems and decisions. 2005. № 4. P. 61-70.

Поиск нового вида сырья для алюминиевой промышленности

В.И. Брагина,
Н.И. Коннова, Л.П. Пехова
Сибирский федеральный университет
Россия 660041, Красноярск, пр. Свободный, 79[1]

В статье представлены результаты исследований по разработке рациональной схемы обогащения руды Базыбайского месторождения (Красноярский край). Определены оптимальные условия получения силлиманитового и кварцевого концентратов.

Ключевые слова: кварц – силлиманитовые сланцы, силлиманитовый концентрат, кварцевый концентрат, Базыбайское месторождение, флотация, мокрая магнитная сепарация, гравитационно-флотационно-магнитная схема, магнитно-флотационно магнитная схема.